## NOTES ON UNDERGROUND RUNNERS.

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Reduction to types is one of the most characteristic features of modern biological science. That very important branch of botany and zoology which is known as morphology has this for its sole object. In all the variety of form and function which the plant world offers we recognize only a few organs, viz.: root, stem, leaf and trichome as distinct from each other, every part of a plant being simply regarded as one, or a modification of one, of these fundamental forms.

It is the same mental habit by which we are influenced in the formation of our ideas regarding the life history of plants. We are accustomed to unify the cycle of their existence; e. g., we say that, in general, a plant arises from seed, that it produces roots, a stem, leaves and, finally, fruit, when the sequence is repeated. Although in reviewing our past experience we are forced to modify our views upon this subject, we do not hesitate to pronounce the foregoing the typical plan of vegetable existence. The more carefully, however, we investigate the development of plants, the more divergences we find in regard to this recognized fundamental method. Especially among the lower forms of vegetation it may be observed that reproduction by fruit gives way with great frequency to bud formations. Nor in the higher forms is the beginning of the vegetable organism to be found in the ovule as often as we are apt to suppose. Such bud formations find expression here in the production of bulbs, tubers, adventitious buds, runners, etc.

So far as the resulting plant is concerned, there is no difference visible, whether it was produced from seed or bud, and it is not until we unearth roots in great numbers that we begin to realize how great is the importance of the method of reproduction by buds in assisting to clothe the earth with vegetation. Every botanist will readily recall many illustrations of this point. One season I spent much time in studying the formation of runners on the bulb of *Erythronium Americanum*, and the result was surprising. Again I dug up a great number of the scaly bulbs of *Oxalis violacea*, and found hardly one without one or more runners issuing from its base.

It appears probable that these runners with incipient plants or bulbs on their tips, in many cases, appear regularly at certain seasons, and their development *may* be confined to certain periods. I observed the beginning of the formation of runners of *Erythronium* in early April, and their subsequent development which lasted at least until June, when bulbs had formed on the ends. The specimens of *Oxalis* referred to above were collected in June, but I have also found runners on the bulbs of this plant in October. My chief reason for putting these few observations together is to direct attention to these points, since the time favorable for this line of work will soon be at hand. Our spring flowers will, without doubt, prove good objects for investigation. It seems reasonable to suppose that the formation of runners will be found to be most active when the plant is not requiring much energy in seed and fruit formation. This certainly seemed to be the case with *Erythronium.* I do not now remember having found any runners on plants in flower, but I collected scores of plants which produced runners actively, but which had not sent up their flowering scapes.

The following is directly in this line: On the 26th of April of last year I came upon a locality near Swarthmore which was overrun to an unusual extent by *Arisæma triphyllum.* I was struck by the marked difference shown by these plants so far as their respective stages of development were concerned, and began to dig up specimens of various degrees of maturity. Upon examination of a young plant such as is represented in Plate III, fig. 1, the corm was just beginning to swell, a number of roots had emerged from it; these were clothed with root-hairs for the soil adhered to them tenaciously. One might naturally conclude that these young plants were seedlings produced from the fruit of the preceding year. A different origin was, however, suggested by other plants of about the same appearance and stage of development. A clue was obtained by such specimens as that represented by fig. 2. The corm was somewhat thicker and the appendage at its lower end was very suggestive. This was brown in color, and was, without doubt, what remained of a shrivelled runner attached at one time to another plant. Upon examination of still younger plants, figs. 3 and 4, no sign of a thickened corm was to be seen, and the rootstock, if such it may be called, was still firm and hard. The attachment to the mother plant was, however, no longer intact.

Fig. 5 represents a plant of considerably larger size. In other respects it did not differ materially from that represented by fig. 2. Unless the truncate end of the corm may be considered as such, every trace of the appendage was lost. This "cut off" appearance did not belong to the body of the corm, for when the shrivelled coating was removed, the lower end revealed a conical shape—fig. 6.

Fig. 7 shows a plant whose leaves and general appearance indicated a further stage of development, although its growth appeared somewhat stunted. Three large buds *z*, had formed. The specimen was interesting on account of the different relative position of corm, stem and roots as compared with the plants represented in the preceding illustrations. The roots here emerged from the base of the corm, while in the other cases described they proceeded from above. A turning of the corm seemed to have taken place, the point through which the axis of rotation may be considered to pass is evidently at the junction of corm and stem. This apparent rotation is probably due to the position in which the terminus of the runner is primarily lodged. At all events, the subject deserves further investigation. The upright stem in all cases obeys, according to the rule, the influence of negative geotropism, the roots are positively geotropic, but the corm itself seems to be quite free from the influence of this force. Physiologically, this is certainly of interest: I do not now recall any similar observations recorded in regard to the effect of geotropism on bulbs produced from underground runners.

Fig. 8 represents a plant considerably larger than that of fig. 7. The corm here had an appearance of partial rotation, while fig. 9 shows a corm from a plant similar to those of figs. 1 and 2, with the appendage below. It is a question, probably only to be decided by statistics, which is the normal position, if there be such a one, in young and mature plants.

To show the variety of form assumed by the corms of *Arisæma triphyllum*, I have outlined a number of these in fig. 10; *a*, *b*, *c*, *d*, *e*, *f* and *g*, all being taken from flowering plants. Some are flat below, *c* and *f*, others are convex, *d* and *e*. Buds are visible in many cases, *z*, and even in these flowering plants the appendage, *ap.*, indicative of the origin of the plant, is not always lost.

In many other respects, this species is extremely interesting. It is remarkable for its variations in size. I have found specimens which were considerably over two feet tall, while again one often comes across flowering dwarfs barely six inches high.

I collected, on the excursion above referred to, 25 spikes for examination, and of these 21 were staminate and 4 pistillate. Of the latter closer examination revealed that on 2 of them some few stamens with ripe anther cells were to be found, the anthers being well-filled with pollen, fig. 11, *p*. The anther cells had burst, and there is no reason why the pollen, in such cases, should not fertilize the ovules in pistils on the same plant, especially since small insects are always found inside the spathe, which may serve to distribute the pollen. Possibly these few stamens may help to ensure fertilization in case cross fertilization should fail, which latter method, for aught I know, may be the usual one. The stigma is so remarkable that I could not refrain from sketching it, fig. 12. It is densely covered with enormous club-shaped hairs which are extremely like the glandular hairs I found producing the jelly-like secretion in the fruit of *Peltandra undulata*. Here and there I found a pollen grain on these hairs, *p*.

Finally: From the numbers cited above, although they cannot be taken to represent the ratio in which staminate and pistillate spikes are to be generally found, it appears, nevertheless, that nature wastes a great deal of energy to secure the formation of fruit by such an excessive production of pollen. We may suppose that all these staminate flowers are produced to ensure fertilization by insects. There occurs to me another point of view to which I am at present somewhat inclined: Every one must admit that in nature there is an inherent tendency under proper conditions to produce flowers even if there may be little chance finally of seed formation, although the ulterior object of the flower is then not accomplished. We know that in the genus *Arisæma* the "flowers are monœcious or by abortion diœcious." It is quite possible that this abortion may have a direct bearing on the method of reproduction described above. I wish to emphasize the point that while the plant obeys this flower forming inclination, the suppression of fruit production on those plants, which by abortion develop only staminate flowers, may serve to increase the tendency to the formation of underground runners. At all events, if we attempt to realize the great number of plants of *Arisæma triphyllum* produced by buds we must admit that the plant with staminate flowers only, is possibly not less prolific than the fruiting one, especially should it be found, as it is to be expected, that the growth of runners from the development of underground buds is more vigorous when the chief energy of the plant is not consumed in fruit formation.

## EXPLANATION OF PLATE III.

Figs. 1, 2, 3, 4, 5, 7, and 8 young plants of *Arisæma triphyllum*, ½ natural size.

Fig. 6, corm of fig. 5, showing conical shape of lower portion after removal of coating; ½ natural size.

Fig. 9, corm with two buds, *z*, and appendage from a plant similar to that represented in VIII; ½ natural size.

Fig. 10, *a*, *b*, *c*, *d*, *e*, *f*, *g*, corms from flowering plants showing a variety of form; ½ natural size.

Fig. 11, pollen grains; the protoplasm is contracted by alcohol; the nucleus, *n*, is very distinct; greatly magnified.

Fig. 12, stigma beset with large club-shaped trichomes, three pollen grains are visible, *p*; greatly magnified.